# LOAN DOCUMENT

PHOTOGRAPH THIS SHEET

AD-A276 971

DTIC ACCESSION NUMBER

LEVEL

1

INVENTORY

ASC-TR-94-5014

DOCUMENT IDENTIFICATION

Aug 93

DISTRIBUTION STATEMENT

ACCESSION FOR
NTIS GRA&I
DTIC TRAC
UNANNOUNCED
JUSTIFICATION

BY
DISTRIBUTION/
AVAILABILITY CODES

| DISTRIBUTION | AVAILABILITY AND/OR SPECIAL | |
|---|---|---|
| A-1 | | |

DISTRIBUTION STAMP

DTIC
ELECTE
MAR 10 1994
C

DATE ACCESSIONED

DATE RETURNED

94-07855

94 3 9 110

DATE RECEIVED IN DTIC

REGISTERED OR CERTIFIED NUMBER

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-FDAC

DTIC FORM 70A JUN 90

DOCUMENT PROCESSING SHEET

PREVIOUS EDITIONS MAY BE USED UNTIL STOCK IS EXHAUSTED.

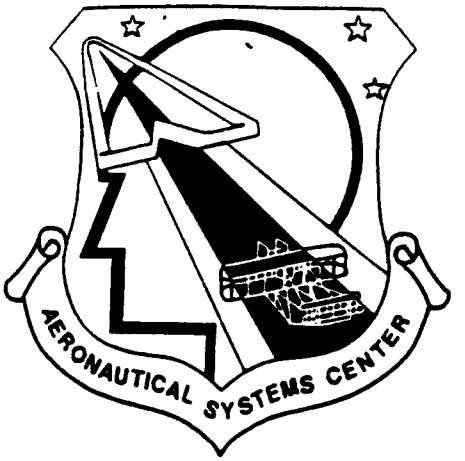
LOAN DOCUMENT

HANDLE WITH CARE

ASC-TR-94-5014

MODULAR SIMULATOR SYSTEM (MSS)

# SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC MODULAR SIMULATOR SYSTEM - FLIGHT DYNAMICS MODULE VOLUME 4




K KELLY, J BROWN,
G KAMSICKAS, W TUCKER

BOEING DEFENSE AND SPACE GROUP
SIMULATION AND TRAINING SYSTEMS
499 BOEING BLVD
HUNTSVILLE, AL 35824

AUGUST 1993

FINAL REPORT



SYSTEMS ENGINEERING DIVISION
AERONAUTICAL SYSTEMS CENTER
AIR FORCE MATERIEL COMMAND
WRIGHT PATTERSON AFB OH 45433-7126

## NOTICE

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely Government-related procurement, the United States Government incurs no responsibility or any obligation whatsoever. The fact that the government may have formulated or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication, or otherwise in any manner construed, as licensing the holder, or any other person or corporation; or as conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

This report is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

JEFFREY C. VALITON, Maj, USAF
Program Manager
Special Programs Divsion

JAMES D. BASINGER
Team Leader
Special Programs Division

JAMES J. O'CONNELL
Chief, Systems Engineering Division
Training Systems Program Office

If your address has changed, if you wish to be removed from our mailing list, or if the addressee is no longer employed by your organization please notify ASC/YTSD, WPAFB, OH 45433-7111 to help us maintain a current mailing list.

Copies of this report should not be returned unless return is required by security considerations, contractual obligations, or notice on a specific document.

# REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188



| 1. AGENCY USE ONLY (Leave blank) | 2. REPORT DATE | 3. REPORT TYPE AND DATES COVERED |
|---|---|---|
| | 13 Aug 93 | FINAL |

**4. TITLE AND SUBTITLE**
System/Segment Specification for the Generic Simulator System-Flight Dynamics Module Volume 4

**5. FUNDING NUMBERS**
F33657-86-C-0149
64227F

**6. AUTHOR(S)**
R. Kelly, J. Brown
G. Kamsickas, W. Tucker

**7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)**
Boeing Defense and Space Group
Simulation and Training Systems
499 Boeing Blvd
Huntsville, AL 35824

**8. PERFORMING ORGANIZATION REPORT NUMBER**
S495-10400D

**9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)**
Aeronautical Systems Center
Systems Engineering Division
Bldg 11 2240 B St Ste 7
Wright-Patterson AFB, OH 45433-7111

**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**
ASC-TR-94-5014

**11. SUPPLEMENTARY NOTES**

**12a. DISTRIBUTION/AVAILABILITY STATEMENT**
Approved for public release;
distribution is unlimited.

**12b. DISTRIBUTION CODE**

**13. ABSTRACT** *(Maximum 200 words)*

This is the Flight Dynamics portion of the generic Modular Simulator System (MSS) specification. It is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. This specification contains specific tailoring instructions for each paragraph. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. It is suggested that the user read the "Modular Simulator Engineering Guide" and the "Modular Simulator Management Guide" prior to tailoring this volume.

**14. SUBJECT TERMS**
Modular Simulator System (MSS)

**15. NUMBER OF PAGES**
35

**16. PRICE CODE**

| 17. SECURITY CLASSIFICATION OF REPORT | 18. SECURITY CLASSIFICATION OF THIS PAGE | 19. SECURITY CLASSIFICATION OF ABSTRACT | 20. LIMITATION OF ABSTRACT |
|---|---|---|---|
| UNCLASSIFIED | UNCLASSIFIED | UNCLASSIFIED | UL |

TABLE OF CONTENTS

TABLE OF CONTENTS (Contd.)

# LIST OF FIGURES

## *PREFACE*

*This generic Modular Simulator System (MSS) segment specification has been developed in accordance with DI-CMAN-80008A, Data Item Description for System/Segment Specifications. This specification meets or exceeds the requirements for MIL-STD-490, Type A, specifications. This specification is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. Training devices may consist of Weapons System Trainers (WST), Operational Flight Trainers (OFT), Cockpit Procedures Trainers (CPT), Part Task trainers (PTT), etc.*

*Tailoring will be necessary to meet specific application requirements. The tailoring must be accomplished so as not to violate the goals and intent of the MSS concept. It is assumed that the user of this document has a familiarity with the MSS design concepts and architecture, the application aircraft training requirements, and general working knowledge of aircraft training systems. It is suggested that the user read the "Modular Simulator System Engineering Design Guide (D495-10440-1) and the "Modular Simulator System Management Guide" (D495-10439-1 prior to tailoring this specification. These guides provide an overview of the MSS architecture, an in-depth discussion on its application, and lessons learned from previous applications.*

*Each segment in the MSS architecture provides a portion of the overall system functionality. Similar functions and operations were grouped in each segment based on past experience, areas of design expertise, and management of intersegment communication. To promote reuse of the segments and gain the maximum benefits of using the MSS approach, it is suggested that the user adhere to the generic functional allocation. Interfaces between the segments should remain relatively constant from application to application. The application vehicle is considered to be an aircraft (e.g. fixed wing, variable geometry, or rotary wing), although the MSS architecture and concepts may be applied to either ground or sea vehicles.*

*This specification contains specific tailoring instructions for each paragraph. The instructions are contained within the paragraphs, and are identified by blank spaces and/or italicized text. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. Paragraphs which do not apply to a particular application should not be deleted. They should be identified as "Not Applicable" to maintain paragraph numbering consistency between volumes and various MSS applications.*

# 1. SCOPE

1.1 Identification. This segment specification establishes the requirements for the Flight Dynamics segment of the _____ *(insert application aircraft type)* Modular Simulator System (MSS). This volume is one of _____ *(insert number of volumes in the application system/segment specification)* volumes which comprise the system/segment specification for the _____ *(insert application aircraft type)* MSS. Volume I of this specification contains system level requirements such as MSS structure, communication architecture, network interface performance, system level diagnostic and test requirements, Ada programming language applicability, adaptability and expansibility, and other requirements which pertain to all volumes.

1.2 System Overview. The Flight Dynamics segment provides for the simulation, stimulation, and/or emulation of the performance characteristics, stability and control characteristics, and aero-elastic effects for the _____ *(insert application aircraft type)* MSS. The functions of the Flight Dynamics segment provide the simulation of the flight characteristics, flight performance, flying/handling qualities, mass properties and structural limits of the aircraft throughout the flight envelope of the ownship. The flight characteristics, flight performance and flying qualities model simulate the air vehicle motion using flight test data, wind tunnel data and derived data as model inputs.

Each of the Flight Dynamics functions identified are processed within the Flight Dynamics segment. The Flight Dynamics Segment interfaces with other MSS segments as described in the _____ *(insert application aircraft type)* MSS Interface Design Document (IDD) _____ *(insert MSS IDD document number)* Each of the Flight Dynamics functions identified are processed within the Flight Dynamics segment.

1.3 Document Overview. This segment specification defines Flight Dynamics unique requirements for the _____ *(insert application aircraft type)* MSS. It contains requirements of the functions performed within the segment including communication interface requirements, segment performance requirements, segment diagnostic and test requirements, and expansibility and adaptability requirements as applicable to the Flight Dynamics segment.

## 2. APPLICABLE DOCUMENTS

2.1 Government Documents. The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

The Government documents which are applicable to the entire _____*(insert application aircraft type)* MSS are listed in Volume I of the system segment specification. The following Government documents are in addition to those documents and specifically applicable to the _____*(insert application aircraft type)* Flight Dynamics segment.

SPECIFICATIONS:

Federal - *(Identify applicable federal specifications)*
Military - *(Identify applicable military specifications)*
Other Government Agency - *(Identify applicable government specifications)*

STANDARDS:

Federal - *(Identify applicable federal standards)*
Military - *(Identify applicable military standards)*
Other Government Agency - *(Identify applicable government standards)*

DRAWINGS: *(Identify applicable drawings)*

OTHER PUBLICATIONS:

Manuals - *(Identify applicable manuals)*
Regulations - *(Identify applicable regulations)*
Handbooks -*(Identify applicable handbooks)*
Bulletins - *(Identify applicable bulletins)*

Copies of specifications, standards, drawings, and publications required by suppliers in connection with specified procurement functions should be obtained from the contracting agency or as directed by the contracting officer.

*(In this paragraph list only those documents which are explicitly referenced within this specification volume. If a requirement paragraph is tailored to reference a system/segment specification Volume I paragraph, and that paragraph contains a reference, the document should not be listed here. All requirements and references in system/segment specification Volume I are requirements of this specification unless specifically excluded in this volume.)*

2.2 Non-Government Documents. The following documents of the exact issue shown form a part of this specification to the extent

specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

The non-Government documents which are applicable to the entire _____ *(insert application aircraft type)* MSS are listed in Volume I of the System Segment Specification. The following non-Government documents are in addition to those documents and specifically applicable to the _____ *(insert application aircraft type)* Flight Dynamics segment.

SPECIFICATIONS - *(Identify applicable non-government specifications)*
STANDARDS - *(Identify applicable non-government standards)*
DRAWINGS - *(Identify applicable non-government drawings)*
OTHER PUBLICATIONS - *(Identify applicable non-government publications)*

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal Agencies.

*(In this paragraph list only those documents which are explicitly referenced within this specification volume. If a requirement paragraph is tailored to reference a system/segment specification Volume I paragraph, and that paragraph contains a reference, the secondary document should not be listed here. All requirements and references in system/segment specification Volume I are requirements of this specification unless specifically excluded in this volume.)*

# 3. SEGMENT REQUIREMENTS

3.1 Segment Definition. The Flight Dynamics segment is one of _____ *(insert number of segments to be used in the application simulation)* unique segments which comprise the _____ *(insert application aircraft type)* MSS. The Flight Dynamics segment shall provide the modes, states, and functions as defined in this specification volume and Volume I.

The Flight Dynamics segment shall provide real-time emulation of the MSS ownship performance characteristics, stability and control characteristics, and aero-elastic effects.capabilities to simulate the _____ *(insert application aircraft type).*

*(This paragraph should be tailored to convey the exact top level functions required of the segment. I f this segment is to be used/reused on several devices within a family of trainers, that should be stated here with any unique performance requirements.)*

3.2 Characteristics

3.2.1 Performance Characteristics. Performance of the Flight Dynamics segment shall be as specified herein and in accordance with the _____ *(insert application aircraft type)* design criteria. The fidelity of the Flight Dynamics segment shall be sufficient to provide the trainee with the aircraft aerodynamic qualities required for the necessary level of training as specified in Volume I, paragraph 6.1 of this specification.

*(Several considerations must be addressed in this paragraph:*

- *a. Availability of specific and traceable flight dynamic design engineering and test data*
- *b. Application aircraft, category normal, transport, utility, acrobatic, etc*
- *c. Weight and balance function modeling requirements*
- *d. Equations of motion modeling requirements, etc.*

*(Additional text should be added to this paragraph to identify design criteria. A general statement with respect to the fidelity of the simulation should be added.)*

3.2.1.1 Segment Modes and States. The Flight Dynamics segment shall support the system modes and states as described in Volume I of this specification. Additional requirements, or operations specific to the Flight Dynamics segment shall not cause degradation of the system nor violate the intent of the system mode or state.

*(Introduction of new modes is prohibited. Functions should be accomplished within the established modes and states. This paragraph should describe the segment's response to a given mode or state. Subparagraphs should be added to identify and define the segment requirements for each mode and state.)*

3.2.1.2 Flight Dynamics Segment Functions. Functions characterized as "Implemented" shall be implemented to the extent described by the paragraphs dedicated to those functions. Functions characterized as "Not Applicable" shall not exist in this simulation of the _____ *(insert application aircraft type)*, and are not required to be implemented in any form within the Flight Dynamics segment.

| | | |
|---|---|---|
| a. | Flight Dynamics Support Function | Implemented |
| b. | Forces and Moments Function | *(Implemented, N/A)* |
| c. | Equations of Motion Function | *(Implemented, N/A)* |
| d. | Weight and Balance Function | *(Implemented, N/A)* |
| e. | Envelope Violation Function | *(Implemented, N/A)* |

*(Each function listed should be characterized as "Implemented" or "Not Applicable (N/A)").*

3.2.1.2.1 Flight Dynamics Support Function. The Flight Dynamics support function shall provide the segment-unique support services required for the operation of the Flight Dynamics segment in the MSS environment. The Flight Dynamics support function services shall include the functions listed below, and as described in the following paragraphs.

a. Executive Control
b. Initialization
c. MSS Virtual Network (VNET) Communication
d. Diagnostics and Test
e. Backdoor Interfacing
f. Malfunctions
g. Damage Assessment
h. Security Processing
i. Scoring
j. Other Support Function Services

*(Service functions are usually incidental to the simulation but no less critical. Examples are overhead and I/O functions. Additional services may be added as necessary to meet specific application requirements. Corresponding subparagraphs need to be added below. Do not reuse paragraphs for support functions that are not applicable.)*

3.2.1.2.1.1 Executive Control. The executive control support service shall provide operational control for the Flight Dynamics segment. This control shall include: execution sequencing of all software segments, mode and state control, and communication between the simulation software and the VNET.

*(For most applications this paragraph will require no tailoring. If additional or specific executive control functions are required, they should be identified in this paragraph.)*

3.2.1.2.1.2 Initialization. The initialization support service shall control initial hardware and software states for the Flight Dynamics segment. System initialization shall occur during power-up and system resets, as defined in Volume I of this specification. The initialization function shall also access mission initialization data, and transfer the data to other segment functions for mission initialization.

*(Initialization requirements unique to the application aircraft Flight Dynamics segment should be specified in this paragraph. Initialization refers to setting initial hardware and software states during power-up and system resets as defined in Volume I. Instrument scale factors and default instrument settings (usually powered off) are typically initialized by this function. A second initialization function is to access mission initialization data (for example from disc ) to pass to other segment functions for mission initialization.)*

3.2.1.2.1.2.1 Forces and Moments Function. The configuration of the aircraft (location, flight controls positions, thrust, center of gravity, weight, moments of inertia of external stores and internal fuel tanks) shall be initialized as required by the specific mission.

*(Define the application specific Forces and Moments Function Initial Conditions.)*

3.2.1.2.1.2.2 Equations of Motion Function. The equations of motion function shall be initialized to a null state (i.e., rates, accelerations, airspeed, etc., equal to zero; altitude equal to on ground, aligned to the takeoff position).

*(Define the application specific Equations of Motion Function Initial Conditions.)*

3.2.1.2.1.2.3 Weight and Balance Function. The weight and balance function shall be initialized with the aircraft empty weight data. The fuel loading, weapons, cargo, chaff and flares shall be initialized as required by the specific mission.

*(Define the application specific Weight and Balance Function Initial Conditions i.e., fuel weight, oil weight, external stores weight and munitions.)*

3.2.1.2.1.2.4 Envelope Violation Function. The application aircraft simulation shall initialize to a non-crash condition.

3.2.1.2.1.3 MSS Virtual Network Communication. The MSS VNET communication support service shall provide the Flight Dynamics segment interface to the MSS VNET. It shall allow communication with other segments in the _____ *(insert application aircraft type)* MSS. The Flight Dynamics segment shall communicate with the MSS VNET in accordance with the protocol requirements defined in the aircraft MSS IDD _____ *(insert IDD document number)*.

3.2.1.2.1.4 Diagnostics and Test. The diagnostics and test support service shall provide control for the diagnostic and test functions incorporated into the Flight Dynamics segment. Diagnostic and test requirements shall be in accordance with the requirements specified herein.

*(Based upon the specific simulator diagnostic requirements, all or part of the three types of diagnostic capabilities may be required. "Not Applicable" should be inserted if the specific diagnostic type is not required for the application MSS. Specific diagnostics and their requirements should be listed in each paragraph when applicable.)*

3.2.1.2.1.4.1 On-Line Diagnostics. On-line diagnostics shall be provided for the Flight Dynamics segment. These diagnostics shall be self initiating during start-up and/or as a background function during training mode.

*(On-line Diagnostics are those diagnostics that executed while the training system is in the real-time training mode. These diagnostics may run as a background task. An example that would be used in an MSS environment might be a segment functional diagnostic. Each segment would tell the IOS segment that it is still functioning on a periodic basis (say once a minute). If the IOS does not receive the message then it assumes the segment is not functioning properly and provides a message to the instructor.)*

3.2.1.2.1.4.2 Off-Line Diagnostics. Off-line diagnostics shall be provided by the Flight Dynamics segment. Off-line diagnostics shall be executed when the _____ *(insert application aircraft type)* MSS is not engaged in a system mode.

*(Off-line Diagnostics are those diagnostics that are performed on a segment in the stand-alone or segment mode. Typical off-line diagnostics would include; hardware self tests, software tests, I/O debug programs, Daily Readiness at a segment level, etc.)*

3.2.1.2.1.4.3 Remote Controlled Diagnostics. Remote Controlled Diagnostics shall be provided by the Flight Dynamics segment. These diagnostics shall be executed from the Instructor Operator Station (IOS) when the MSS is the Remote Controlled Diagnostic mode.

*(Remote Controlled Diagnostics are those diagnostics that run in the special remote controlled diagnostic mode. These diagnostics require the system to be up and running and the segments communicating. An example of a Remote Controlled Diagnostic would be a real-time debugger.)*

3.2.1.2.1.5 Backdoor Interfacing. The backdoor interface support service shall provide the means to support external interfaces to the Flight Dynamics segment. All ownship weapon system Input/Output (I/O) not specifically identified in the _____ *(insert application aircraft type)* MSS IDD shall interface via dedicated

hardware interfaces. Backdoor interfaces shall not be utilized for normal intersegment communication.

*(Specific external interfaces should be identified in this paragraph. Backdoor interfaces may include a 1553 bus to communicate with installed aircraft avionics or a specialized interface to drive a Head-Up Display (HUD). A backdoor interface may not be utilized to transmit intersegment data.)*

3.2.1.2.1.6 Malfunctions. The malfunctions support service shall provide the control for the processing and execution of the Flight Dynamics segment malfunctions. The system response shall be in accordance with the aircraft design criteria.

*(The Flight Dynamics segment malfunctions should be defined in a program unique Malfunction Description Document ).*

3.2.1.2.1.7 Damage Assessment. The damage assessment support service shall provide for the processing and implementation of any damage simulation for which the Flight Dynamics segment is responsible. This shall include the degradation of the appropriate systems within the Flight Dynamics segment based upon the evaluation of the damage severity and location.

*(Based upon the training requirements of the application aircraft MSS, any specific damage assessment and system degradation requirements should be specified in this paragraph. i.e., a non-fatal hit by an other-ship weapon causing flight dynamic abnormalities.)*

3.2.1.2.1.8 Security Processing. The Flight Dynamics segment security processing support service shall provide for the processing of the security requirements of the _____ *(insert application aircraft type)* MSS.

*(This paragraph should be expanded to clearly specify which government directives apply, and to what extent, consistent with security considerations. Security processing could include Memory Erase Mode if required and any other security considerations such as removable memory or special encoding devices.)*

3.2.1.2.1.9 Scoring. The scoring support service shall provide the ability to collect specific data for the assessment of a student's performance in his utilization of the Flight Dynamics segment's capabilities. The Flight Dynamics segment scoring data shall be provided to the IOS segment via the MSS VNET.

*(Application specific scoring data requirements for the Flight Dynamics segment shall be listed in this paragraph. If large amounts of data are required, it may be advisable to provide this to the IOS as a non-real-time activity.)*

3.2.1.2.1.10 Other Support Function Services. Not Applicable.

*(If there are other support functions unique to this segment they should be listed here, otherwise identify this paragraph as "Not Applicable". Intrasegment communication is an example of a function that might be listed in this paragraph. Before defining new functions, be sure the function cannot be incorporated as a variant of an existing function.)*

3.2.1.2.2 Forces and Moments Function. The Forces and Moments function shall determine the total (body-axis) forces and moments applied to the damaged or undamaged _____ *(insert application aircraft type)* MSS training device. This shall include forces and moments due to external stores (munitions, fuel tanks,etc). The forces and moments function shall perform forces and moments calculations based on the configuration of the aircraft (location, center of gravity (cg), weight, moments of inertia of all external stores and internal/external fuel tanks) provided by the weight and balance function. Internal calculations from the forces and moments function of the Flight Dynamics segment shall include the following:

a. Translational aerodynamic coefficients (drag, lift,sideforce).
b. Rotational aerodynamic coefficients (pitch, yaw, roll).
c. Externals aerodynamic coefficients.
d. Aerodynamic forces and moments including the application of instructor commanded wind effects.
e. Application of the engine torque (gyro, P-factor, and slip stream) moments.
f. Stores release and weapons firing effects.
g. Ground handling forces and moments including the effects of braking, steering, arresting hooks and drag chutes.
h. Conversion of thrust forces to the body axes forces and moments and the application of these forces and moments.

Body-axis forces and moments due to the _____ *(insert application aircraft type)* propulsion system shall be calculated. Engine moments of inertia shall be a constant.

Forces and moments on the _____ *(insert application aircraft type)* due to proximity to the ground and other aircraft shall be calculated. Calculations concerning other aircraft shall be based on data from the MSS VNET.

Stores release and weapons firing effects shall be simulated and shall include the release or explosive firing of chaff, flares, and munitions.Aerodynamic forces and moments due to weapon damage and/or soft crash shall be simulated based on damage severity and damage type as defined by the damage assessment area of the support function.

*(The following requirements considerations should be addressed for forces and moments, based on training requirements:*

*a. Forces and moments degraded modes of operation required (malfunctions, battle damage, and/or aero icing)*
*b. External forces operating on the airframe (wind, weapon detonation, weapon launch, flow fields, external pods, ground reactions and propulsion)*
*c. Aerodynamic data base design criteria required*
*(1) Type of flight controls (tabs, ports, bounty layer control, variable wing sweep, reaction control system, variable camber, or surfaces)*
*(2) Type of propulsive force used (jet, rotor or propellers)*

*Tailoring of this paragraph may involve adding references to the appropriate design criteria for the engines and weapons. If possible, an attempt should be made to quantify the fidelity requirements.)*

3.2.1.2.3 Equations of Motion Function. The equations of motion function determines the state of the simulated aircraft. The state of the aircraft shall include translational accelerations, velocities, and positions; and rotational accelerations, velocities and positions. The state of the aircraft shall be provided in the WGS-72 Earth Axis Coordinate System to the MSS VNET as defined in the IRS.

*(The following considerations should be addressed for equations of motion, based on training requirements:*

*a. Envelope singularities*
*b. Equation of motion external inputs required in this simulation (Wind speed, wind direction, altitude demand, heading demand, speed demand, and/or turbulence)*
*c. Equations of motion crew observables are required (slip and skid, turn rate, airspeed, altitude, angle of attack, vertical velocity, heading, roll, Mach and pitch)*
*d. Special envelope considerations (supersonic, hypersonic, exoatmosperic, and/or orbital)*

*Fidelity critical areas (e.g. low speed flight, asymmetric thrust, etc.) should be listed here. The most important is synchronization of motion, flight dynamics and cockpit cues.)*

3.2.1.2.4 Weight and Balance Function. The weight and balance function provides the stores configuration changes and mass property changes of the simulated aircraft. The weight and balance function shall maintain complete mass properties information about the _____ *(insert application aircraft type)* configuration. This information shall include basic aircraft dry weight configuration data, fuel data, cargo data, chaff and flares and weapon stores data. Data is defined as type and location, weight, cg (x, y and z body-axis locations) and moments

of inertia of each component.

Internal data about the dry (no fuel loaded) aircraft shall be combined with fuel quantities per tank, cargo data, chaff and flares, and weapons stores data to determine aircraft weight, cg position and moments of inertia. The capability to allow for a instructor commanded cg position change by a direct offset of the cg, a movement of onboard cargo, and movement of fuel between tanks within the constraints of the fuel system based on instructor direction shall be provided.

*(The following considerations should be addressed for weight and balance, based on training requirements:*

*a. Weight and balance degraded modes of operation required (malfunctions, battle damage and/or ice weight)*
*b. Weight and balance ancillary functions required (heat loads, electric loads, hydraulic loads and/or pneumatic loads)*
*c. Weight and balance external inputs acting on the air frame (wing position, empty weight, weapon weights, weapon resets, fuel weights, fuel reset, chaff and flare weights, chaff and flare reset, cargo weight, cargo position, and/or center of gravity bias)*
*d. Weight and balance crew observables required (center of gravity limits, projected center of gravity, fuel weight, total weight, center of gravity and/or cautions and warnings?)*

3.2.1.2.5 Envelope Violation Function. The envelope violation function provides the capability to monitor flight parameters to determine violation of the structural, temperature or dynamic pressure envelopes of the simulated aircraft.

The envelope violation function shall monitor critical flight parameters of the simulated aircraft to determine if structural capacities of the aircraft have been exceeded which would result in a crash condition. The crash conditions shall include as a minimum: exceeding aircraft structural limitations in flight, excessive vertical and side velocities at touchdown, exceeding aircraft structural limitations on the ground or in flight, collision with terrain (other than landing on an airfield), collision with a companion vehicle, collision with a hostile aircraft and weapons damage. A crash override capability shall be provided by the envelope violation function and activated/ deactivated based on instructor demands in autonomous operation.

*(Tailor this paragraph so that it contains a complete listing of the parameters that will cause a crash condition on the application aircraft. Determining crash conditions as a result of exceeding structural limits will require specifying adherence to appropriate design criteria. Crash conditions involving collisions with environmental objects may be specified here only if that function has not been allocated to another segment. Care should be exercised to ensure that*

*collision detection is properly allocated and allocated singularly.*

*The following considerations should be addressed for the envelope violation function, based on training requirements:*

a. *Envelope violation external inputs required (such as crash override)*
b. *Envelope violation crew observables required (freeze, aural cueing, visual "red-out" and/or caution and warnings)*
c. *Other crash conditions defined here (e.g., landing gear not down when landing, landing not on runway, exceeding aircraft skin temperature, exceeding "G" limits, exceeding dynamic pressure, exceeding Mach limits, etc.)*

3.2.2 System Capability Relationships. The Flight Dynamics segment shall support the capability relationships defined in Volume I of this specification. Flight Dynamics segment functional relationships shall be as described in the following paragraphs.

*(Define any Flight Dynamics segment unique capability relationships. In general, the capability relationships specified in Volume I will suffice for this segment.)*

3.2.2.1 Segment Functional Relationships. The top level, typical, Flight Dynamics segment functional relationships are depicted in FIGURE 1. Each function shall operate in a manner which will allow the segment, as a system, to satisfy the timing requirements described in Volume I of this specification. Functions implemented within the Flight Dynamics segment shall operate in such a manner which will allow the segment to meet both segment and system level requirements without degradation.

*(There are two approaches to describing intra-segment interfaces: all functions communicate through the support function, or all functions communicate directly with other functions. FIGURE 1 in all segments may have the same structure. For this segment, functions which are not implemented should be shaded out. If desired, functions which are only partially implemented may be graphically represented with cross hatching. The intent of FIGURE 1 should be to identify "required" internal relationships and not to specify the segment internal design. The tailoring of this paragraph should be done very carefully. )*

3.2.3 External Interface Requirements. The Flight Dynamics segment shall support the external interface requirements defined in Volume I of this specification and the _____ *(insert application aircraft type)* MSS Interface Requirements Specification (IRS). External interfaces are comprised of data passed between Flight Dynamics functions and functions contained in other MSS segments. With the exception of the dedicated interfaces for the cockpit, all other external interfaces which shall be used for the Flight Dynamics segment are specified in the _____ *(insert application aircraft type)* MSS IRS.

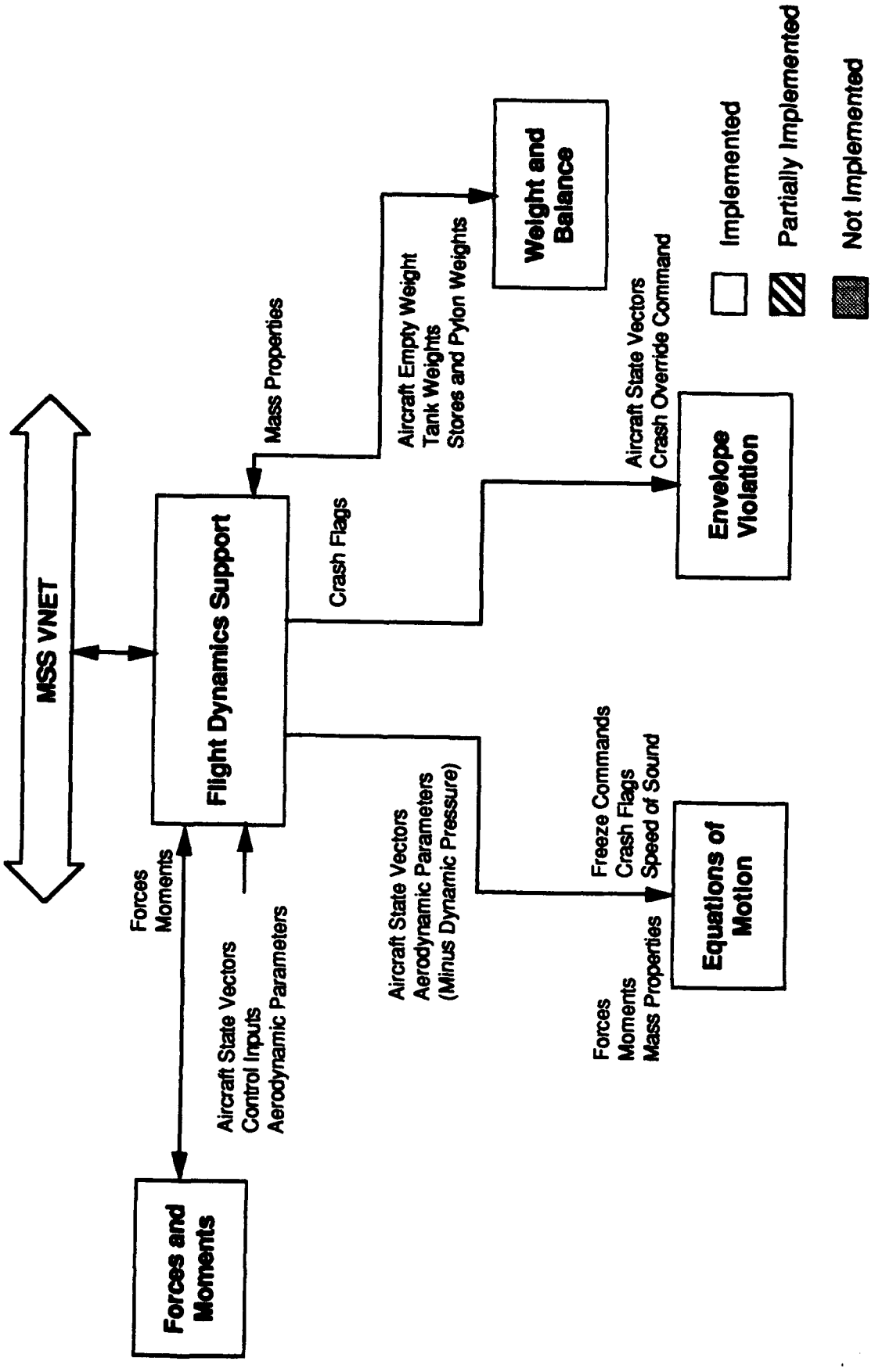



FIGURE 1 FLIGHT DYNAMICS SEGMENT FUNCTIONAL RELATIONSHIPS

*(Define any Flight Dynamics segment unique external interface requirements. External facility interfaces for primary power, cooling, floor space, etc., should be identified here or specifically referenced in volume I.)*

3.2.4 Physical Characteristics. The physical characteristics of the Flight Dynamics segment shall meet the requirements as specified in Volume I of this specification. The Flight Dynamics segment physical characteristics shall be of such design as to interface with the other MSS segments via the MSS VNET.

*(Physical characteristics requirements for the Flight Dynamics segment, other than those provided by the Flight Dynamics segment computational system and its interface to the MSS VNET shall be defined in this paragraph. Physical characteristic requirements may include backdoor interface hardware to connect Flight Dynamics segment (I/O) to the application aircraft cockpit. In addition, any weight or size considerations applicable to the Flight Dynamics segment should be considered.)*

3.2.4.1 Protective Coatings. Flight Dynamics segment protective coatings shall be as defined in Volume I of this specification.

*(Additional protective coating requirements which are required for the Flight Dynamics segment may be defined in this paragraph. In general, the requirements of Volume I should suffice for the entire system.)*

3.2.5 Flight Dynamics Segment Quality Factors

3.2.5.1 Reliability. The system level reliability requirements applicable to all segments in the MSS are defined in Volume I of this specification. The Flight Dynamics segment reliability must be _____ % to satisfy the system level reliability requirements. The Mean Time Between Critical Failure (MTBCF) shall not be less than _____ hr.

*(A specific allocation of reliability (e.g. MTBCF) for this segment should be specified in this paragraph. Reliability should be allocated to each segment in such a way that system level reliability requirements will be met. Normally this means that segment reliability will be higher than system reliability. )*

3.2.5.2 Maintainability. The system level maintainability requirements applicable to all segments in the MSS are defined in Volume I of this specification. The Flight Dynamics segment shall have a mean corrective maintenance time, of ____ minutes, and a 90th percentile maximum corrective maintenance time of ____ minutes to satisfy the system level maintainability requirements.

*(Maintainability requirements such as Mean Time to Repair (MTTR ) should be allocated to each segment in such a way that system level maintainability requirements will be met.*

*Normally this means that segment MTTR will be higher than system MTTR. System level requirements will include isolation to a faulty segment.)*

3.2.5.3 Availability. The system level availability requirements applicable to all segments in the MSS shall be as defined in Volume I of this specification.

*(Usually, availability applies only to the system level. Reliability and Maintainability (MTBF and MTTR) should be allocated to each segment in such a way that system availability requirements will be met. It would be unusual to impose an availability requirement at the segment level .)*

3.2.5.4 Additional Quality Factors. The additional quality factors, as defined in Volume I of this specification, shall apply to Flight Dynamics segment.

*(Additional Flight Dynamics segment unique quality factors may be defined in this paragraph. In general, the system level additional quality factors will suffice for the Flight Dynamics segment.)*

3.2.6 Environmental Conditions. The environmental conditions requirements, as defined in Volume I of this specification, shall apply to Flight Dynamics segment.

*(Identify any Flight Dynamics segment unique environmental requirements. In general, the system level environmental conditions will suffice for the Flight Dynamics segment.)*

3.2.7 Transportability. The transportability requirements, as defined in Volume I of this specification, shall apply to Flight Dynamics segment.

*(Identify any Flight Dynamics segment unique transportation requirements. There may exist unique transportation requirements to ship the segment from the segment contractors facility to the prime contractors facility. In general, the system level transportability requirements will suffice for the Flight Dynamics segment.)*

3.2.8 Flexibility and Expansion. The flexibility and expansion requirements, defined in Volume I of this specification, shall apply to the Flight Dynamics segment.

*(Unique requirements for this segment may include spare memory, spare time, spare mass storage, I/O channels by type, chassis expansion slots, etc. Expansion requirements should consider the likelihood this segment will need to change as well as the cost of including capability now versus cost to change later. Reuse of the segment in future applications should also be considered and specified.)*

3.2.9 Portability. The portability requirements, defined in Volume I of this specification, shall apply to the Flight Dynamics segment.

*(Except for field transportable trainers, portability of hardware is usually not a requirement. Portability of software may be a concern for future changes which may include upgrading the Computer Hardware Configuration Item (HWCI ) are considered likely. Use of a standard higher order language such as Ada is usually adequate to assure software portability.)*

3.3 Design and Construction. The design and construction requirements, defined in Volume I of this specification, shall apply to the Flight Dynamics segment.

*(Identify any Flight Dynamics segment unique design and construction requirements. In general, the system level design and construction requirements will suffice for the Flight Dynamics segment.)*

3.3.1 Materials. The materials requirements, defined in Volume I of this specification, shall apply to the Flight Dynamics segment.

*(Identify any Flight Dynamics segment unique materials requirements. In general, the system level materials requirements will suffice for the Flight Dynamics segment.)*

3.3.1.1 Toxic Materials. The toxic materials requirements, defined in Volume I of this specification, shall apply to the Flight dynamics segment.

*(Identify any Flight Dynamics segment unique toxic materials requirements. In general, the system level toxic materials requirements will suffice for the Flight Dynamics segment.)*

3.3.2 Electromagnetic Radiation. The electromagnetic radiation requirements, defined in Volume I of this specification, shall apply to the Flight Dynamics segment.

*(Identify any Flight Dynamics segment unique electromagnetic radiation requirements. In general, the system level electromagnetic radiation requirements will suffice for the Flight Dynamics segment.)*

3.3.3 Nameplates and Product Marking. The nameplate and product marking requirements, defined in Volume I of this specification, shall apply to the Flight Dynamics segment.

*(Identify any Flight Dynamics segment unique nameplate and product marking requirements. In general, the system level nameplate and product marking requirements will suffice for the Flight Dynamics segment.)*

3.3.4 Workmanship. The workmanship requirements, defined in Volume I of this specification, shall apply to the Flight Dynamics segment.

*(Identify any Flight Dynamics segment unique workmanship requirements. In general, the system level workmanship requirements will suffice for the Flight Dynamics segment.)*

3.3.5 Interchangeability. The interchangeability requirements, defined in Volume I of this specification, shall apply to the Flight Dynamics segment.

*(Identify any Flight Dynamics segment unique interchangeability requirements. In general, the system level interchangeability requirements will suffice for the Flight Dynamics segment.)*

3.3.6 Safety. The safety requirements, defined in Volume I of this specification, shall apply to the Flight Dynamics segment.

*(Identify any Flight Dynamics segment unique safety requirements. In general, the system level safety requirements will suffice for the Flight Dynamics segment.)*

3.3.7 Human Engineering. The human engineering requirements, defined in Volume I of this specification, shall apply to the Flight Dynamics segment.

*(Identify any Flight Dynamics segment unique human engineering requirements. In general, the system level human engineering requirements will suffice for the Flight Dynamics segment.)*

3.3.8 Nuclear Control. The nuclear control requirements, defined in Volume I of this specification, shall apply to the Flight Dynamics segment.

*(Identify any Flight Dynamics segment unique nuclear control requirements. In general, the system level nuclear control requirements will suffice for the Flight Dynamics segment.)*

3.3.9 System Security. The system security requirements, defined in Volume I of this specification, shall apply to the Flight Dynamics segment.

*(Identify any Flight Dynamics segment unique system security requirements. In general, the system level system security requirements will suffice for the Flight Dynamics segment.)*

3.3.10 Government Furnished Property. Government Furnished Property (GFP) shall be as identified in Volume I of this specification.

*(Identify any Flight Dynamics segment unique GFP requirements. In general, the system level GFP requirements will suffice for the Flight Dynamics segment.)*

3.3.11 Computer Resource Reserve Capacity. The system level reserve capacity requirements applicable to all segments in the MSS are defined in Volume I of this specification.

*(In addition to the computer resource reserve capacity identified in Volume I, the specific reserve capacity for the Flight Dynamics segment may include the computational system hardware and software required to design, develop, and test the Flight Dynamics segment. System considerations such as spare (time, memory, storage, I/O channels) for growth unique to this segment should be imposed here. If this paragraph requires subparagraphs they should follow the numbering and topics used in Volume I.)*

3.4 Documentation. The documentation requirements, defined in Volume I of this specification, shall apply to the Flight Dynamics segment.

*(Identify any Flight dynamics segment unique documentation requirements. Documentation requirements for the Flight Dynamics segment may include interface specifications and design data for interfacing to an embedded piece of equipment. In general, the system level documentation requirements will suffice for the Flight Dynamics segment.)*

3.5 Logistics. The system level logistics requirements for the Flight Dynamics segment shall be as specified in Volume I of this specification, paragraph 3.5, and all subparagraphs of paragraph 3.5.

*(Unique support requirements for this segment should be described here. These may include special tools and jigs for installation, alignment and calibration; special environmental conditions for operation and repair such as a clean-room for component repairs; levels and types of spares required; number, skills and training for maintenance personnel.)*

3.6 Personnel and Training. The system level personnel and training requirements, defined in Volume I of this specification, shall apply to the Flight Dynamics segment.

*(Identify any Flight Dynamics segment unique personnel and training requirements. In general, the system level personnel and training requirements will suffice for the Flight Dynamics segment.)*

3.7 Subordinate Element Characteristics. Not Applicable.

*(This volume defines requirements for a subordinate element of the MSS. In general, there will be no subordinate elements of a segment.)*

3.8 Precedence. The precedence requirements for the Flight Dynamics segment shall be as specified in Volume I of this specification.

## 4. QUALIFICATION REQUIREMENTS

4.1 Responsibility For Test and Inspection. The _____ *(insert application aircraft type)* MSS responsibility For test and inspection requirements are defined in Volume I of this specification. The requirements defined in Volume I shall apply to the Flight Dynamics segment.

*(This paragraph may be tailored to identify additional test or inspection requirements which are specific to the Propulsion segment)*

4.2 Special Tests and Examinations. The system level general qualification events, levels, and methods of testing for the Flight Dynamics segment are defined in Volume I of this specification. The requirements defined in Volume I shall apply to the Flight Dynamics segment.

*(Clearly identify which test events defined in Volume I apply to this segment. Be particularly explicit about the segment builder's responsibility during system integration and test. However, in some cases, verification can only be achieved in the integrated mode. A clear definition of the segment supplier's responsibility during systems integration should be contained in the SOW.*

*This paragraph may be tailored to identify additional test or inspection requirements which are specific to the Flight Dynamics segment. The following list contains examples of special tests that may be required depending on the application aircraft specific verification requirements.*

a. *Flight Dynamics, Flight Controls, and Propulsion Segments Subjective Integrated Tests: Although thorough and complete design data will reduce the amount of subjective tuning and testing that may be required, a subjective test to confirm proper integration of the Flight Dynamics, Flight Controls and Propulsion systems will still be required.*

b. *Autotests: These tests are initiated from the IOS for the purpose of segment and integrated performance testing. Autotests provides repeatable results in a much shorter period of time than pilot in the loop tests. This may be for acceptance testing or simulator certification. The types and extent of test to be included will be driven by the support concept and availability requirements of the system and their allocation to this segment. Autotest may be used for acceptance by the procurement agency and certification by the user or FAA (SIMCERT/AC120-40). Consideration must also be given whether or not design criteria only or design criteria plus subjective tuning will be used when determining pass/fail criteria for autotest.*

*Responsibility for integrated tests should be minimized at the segment level. If the segment is required to pass an integrated test, as part of its acceptance, that test(s) should be called out here. Additional tests might include segment compliance tests which can only be performed with the segment installed as part of a system. These should be identified here and the requirements*

*detailed by adding subparagraphs.)*

4.3 Requirements Cross Reference. A requirements compliance cross reference matrix shall be developed to ensure requirement traceability. The requirements cross reference matrix shall be included as part of the _____ MSS Prime Item Development Specification (PIDS).

5. PREPARATION FOR DELIVERY. The _____ *(insert application aircraft type)* MSS preparation for delivery requirements, as defined in Volume I of this specification, shall apply to the Flight Dynamics segment.

*(Segment unique requirements may include packaging the segment for shipment to the integration location which could be different than packaging the system for shipment to the installation site. If requirements are imposed here, there may be test requirements for verification which must be added to Section 4.)*

6. NOTES

6.1 Intended Use. The _____ *(insert application aircraft type)* MSS shall be used as an integral part of the _____ *(insert application aircraft type)* aircraft training system.

6.1.1 Missions. The Flight Dynamics segment shall support the mission requirements, as described in paragraph 6.1.1 of Volume I of this specification. It shall provide the Flight Dynamics portion of simulation and training in cockpit familiarization, flight characteristics, operating procedures, and mission procedures for the _____ *(insert application aircraft type)* MSS. The Flight Dynamics simulation shall assist in allowing the trainee to become familiar with the cockpit configuration and flight characteristics of the aircraft, gain proficiency in executing normal procedures, in recognizing malfunctions/abnormal indications and executing the corresponding emergency procedures, and in executing mission procedures. Normal procedures and emergency procedures specified herein shall be taken from the aircraft Technical Orders (T.O.s) for the _____ *(insert application aircraft type)*. The trainees may range in experience from newly designated aviators undergoing initial training to experienced aviators undergoing refresher training.

*(The Flight Dynamics segment mission is to support the trainer mission as described in Volume I. Any mission specific information should be described in this section. An example would be a segment intended to support a family of trainers such as a procedures trainer, part-task trainer, flight trainer, or weapons system trainer. Another example could be a requirement to support "Aerial Refueling" which would require simulation of the ownship bow wave and tanker interaction.)*

6.1.2 Threat. Not applicable.

*(This paragraph shall describe the threat which the system is intended to neutralize. In this context, this paragraph is not applicable to most simulators, and will generally remain "not applicable".)*

6.2 Flight Dynamics Segment Acronyms. The acronyms contained in this paragraph are unique to the Flight Dynamics segment and are in addition to the MSS acronyms contained in Volume I of this specification, paragraph 6.1.

| | |
|---|---|
| CG | Center of Gravity |
| DOD | Department of Defense |
| FAA | Federal Aviation Authority |
| GFP | Government Furnished Property |

| | |
|---|---|
| IDD | Interface Design Document |
| I/O | Input/Output |
| IOS | Instructor Operator Station |
| IRS | Interface Requirements Specification |
| MSS | Modular Simulator System |
| MTBCF | Mean Time Between Critical Failures |
| N/A | Not Applicable |
| PIDS | Prime Item Development Specification |
| T.O.s | Technical Orders |
| VNET | Virtual Network |

6.3 Glossary of Flight Dynamics Segment Terms. The terms contained in this paragraph are unique to the Flight Dynamics segment and are in addition to the MSS terms contained in Volume I of this specification, paragraph 6.2.

AERODYNAMIC COEFFICIENT - A non-dimensional representation of an aerodynamic force or moment. Also refers to aerodynamic stability derivatives.

AERODYNAMIC FORCES AND MOMENTS - Forces and moments generated by the dynamic air pressure acting on a body.

AERODYNAMIC PARAMETERS - A set of parameters which include: angle of attack, sideslip angle, Mach number, pressure altitude, dynamic pressure and true airspeed.

AEROELASTIC FORCES - The aerodynamic changes due to structural distortion from aerodynamic loads.

AIRCRAFT EMPTY WEIGHT - The weight of an aircraft without any fuel, cargo or weapons on board.

AIRCRAFT GROSS WEIGHT - The total weight of an aircraft including any cargo, weapons and fuel it may be carrying internally or externally

AIRCRAFT STATE VECTORS - The angular and linear positions, velocities and accelerations of an aircraft.

AMBIENT - Refers to static environmental conditions at the position of the body.

ANGLE OF ATTACK - That measurement which provides the angle between the airstream and the aircraft horizontal reference plane. That reference plane is commonly the body-axis xy-plane or the wing chord plane.

BODY-AXIS - A Cartesian coordinate system which is located at the body's center of gravity.

CALIBRATED AIRSPEED - The indicated airspeed corrected for installation error

CENTER OF GRAVITY (CG or cg) - The location along an axis at which the moments caused by weight distribution on one side offset the moments caused by weight distribution on the other side. A center of gravity exists for any given body along each of its 3 body axes.

CONTROL INPUTS - Changes made by the pilot which affect the internal or external configuration of the aircraft. These changes normally refer to primary or secondary flight control inputs such as ailerons, elevator and rudder control inputs or flaps and landing gear extension. However, they may also refer to the deployment of an arresting hook or a drag chute. In some cases, this term may be used to denote the firing of weapons or dropping of bombs.

CRASH FLAGS - Logical operators within the simulation generated by software segments to indicate when aircraft operating capabilities or envelope violations have been exceeded.

CRASH OVERRIDE COMMAND - A logical operator generated by the instructor to indicate to any segments which might generate "Crash Flags" that these flags should not be raised.

CREW STATION - The area of the vehicle in which the aircraft flight or operation crew resides.

DAMAGE ASSESSMENT - The evaluation of injury and the appropriate degradation of the system affected.

DYNAMIC PRESSURE - The air pressure caused by the movement of a body through the air.

EMULATION - The imitation of a device or system.

ENVELOPE VIOLATION - The departure of a simulated body from the normal regime of operation.

EQUIVALENT AIRSPEED - The calibrated airspeed corrected for compressibility effect.

EQUATIONS OF MOTION - The equations used to describe the dynamics of the simulated body. These equations are derived from Newton's Second Law. They use the forces and moments acting on the body and the mass properties of the body to produce linear and angular accelerations.

EXTERNAL STORES - Objects (normally fuel tanks, bombs or missiles) carried on the outside of an aircraft.

FLIGHT CHARACTERISTICS - The flying and handling qualities of the air vehicle. These are typically based on the aerodynamic design of the air vehicle.

FLIGHT DYNAMICS - Characteristics of a body in motion which are used to describe that motion.

FLIGHT PERFORMANCE - The determination of range, maximum speed, cruise speed, stall speed, climb performance, take-off performance and landing performance.

FORCES AND MOMENTS - Forces and moments acting on a simulated body.

FREEZE COMMANDS - Directions given by the instructor to limit the simulation in some manner. The limitation imposed may range from the halt of the integration of fuel usage (normally referred to as Fuel Freeze) to the complete stop of the simulation (normally referred to as Total Freeze).

GYROSCOPIC MOMENTS - Moments created by the rotation of a body or member of a body, such as engine turbines.

INDICATED AIRSPEED - The airspeed displayed by the airspeed indicator.

INSTRUCTOR/OPERATOR STATION - Provides the central point of control for the entire air vehicle trainer. The primary user of the IOS is the training instructor. Secondary users may consist of students and maintenance technicians. The IOS segment provides the capabilities for simulator status and control, controls disagreement and crew (trainee) performance monitoring and measurement. Simulator status and control capabilities will include ownship, navigation/ communication, environment, and missions. The IOS may be responsible for the control and monitoring of either one or many simulation devices depending on the specific application.

MACH NUMBER - The ratio between the aircraft velocity and the speed of sound at the same conditions.

MASS PROPERTIES - Data defining body mass properties, including: center of gravity (in x, y z body-axis), body gross weight and moments of inertia.

MOMENTS OF INERTIA - Forces resistive to rotation acting within a body due to its own mass distribution about its own body axes.

PRESSURE ALTITUDE - The distance above sea level which, on a standard day, measured with pressure sensing altimeters set at 29.92 inches of mercury, would be the same as the geometric altitude.

ROTATIONAL - Relating to moments acting about one of the body or stability axes.

SPEED OF SOUND - The velocity at which pressure waves propagate through air. This velocity is a function of atmospheric temperature, which is a function of altitude.

STAGNATION - Refers to static conditions at a point on the body.

STATE OF THE AIRCRAFT - Refers to information contained in the aircraft state vectors.

STRUCTURAL LIMITS - A threshold, which if surpassed, would result in structural failure to the vehicle. The threshold limits are most often expressed as loads imposed on the air vehicle.

TRANSLATIONAL - Relating to forces acting along one of the body or stability axes.

THRUST - The propulsive force produced by a jet engine or a unit of measure of the propulsive force.

THRUST FORCES - Forces acting on a body normally generated by a propulsive device such as a jet engine.

TRUE AIRSPEED - The equivalent airspeed corrected for air density.

WEIGHT AND BALANCE - Refers to a segment which produces the mass properties of a simulated body.

WIND TUNNEL DATA - Substantiating or design data obtained directly from wind tunnel testing on a prototype or scale model.

| ACTIVE PAGE RECORD | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PAGE NO. | REV LTR | ADDED PAGES | | | | PAGE NO. | REV LTR | ADDED PAGES | | | |
| | | PAGE NO. | REV LTR | PAGE NO. | REV LTR | | | PAGE NO. | REV LTR | PAGE NO. | REV LTR |
| IV-1 | D | | | | | | | | | | |
| IV-2 | D | | | | | | | | | | |
| IV-3 | D | | | | | | | | | | |
| IV-4 | D | | | | | | | | | | |
| IV-5 | D | | | | | | | | | | |
| IV-6 | D | | | | | | | | | | |
| IV-7 | D | | | | | | | | | | |
| IV-8 | D | | | | | | | | | | |
| IV-9 | D | | | | | | | | | | |
| IV-10 | D | | | | | | | | | | |
| IV-11 | D | | | | | | | | | | |
| IV-12 | D | | | | | | | | | | |
| IV-13 | D | | | | | | | | | | |
| IV-14 | D | | | | | | | | | | |
| IV-15 | D | | | | | | | | | | |
| IV-16 | D | | | | | | | | | | |
| IV-17 | D | | | | | | | | | | |
| IV-18 | D | | | | | | | | | | |
| IV-19 | D | | | | | | | | | | |
| IV-20 | D | | | | | | | | | | |
| IV-21 | D | | | | | | | | | | |
| IV-22 | D | | | | | | | | | | |
| IV-23 | D | | | | | | | | | | |
| IV-24 | D | | | | | | | | | | |
| IV-25 | D | | | | | | | | | | |
| IV-26 | D | | | | | | | | | | |
| IV-27 | D | | | | | | | | | | |
| IV-28 | D | | | | | | | | | | |
| IV-29 | D | | | | | | | | | | |

| REVISIONS | | | |
|---|---|---|---|
| LTR | DESCRIPTION | DATE | APPROVAL |
| A | BMAC-STS-86-303-1<br>Total revision required to incorporate changes required by testing/validation efforts and Government comments. | 91/01/11 | Prepared By |
| | | 91/01/11 | Checked By |
| | | 91/01/14 | Dwg. Qual. |
| | | 91/01/11 | Supervised By |
| | | 91/01/15 | Approved By |
| B | CCP HSV-H91-008<br>Total revision required to incorporate changes resulting from addition of two new specifications and new functional allocation. Damage Assessment and Scoring were added to the module support function. | 91/06/26 | Prepared By |
| | | 91/06/26 | Checked By |
| | | 91/06/26 | Dwg. Qual. |
| | | 91/06/27 | Supervised By |
| | | 91/06/27 | Approved By |

CCP 91/01/17

MC 91/6/28

DD-6000-4530 ORIG. 12/87

| REVISIONS | | | |
|---|---|---|---|
| LTR | DESCRIPTION | DATE | APPROVAL |
| C | CCP HSV-H91-008<br><br>Total revision required tc incorporate Government comment on document. | 91-09-26<br><br>91-09-26<br><br>91/09/26<br><br>91-09-26<br><br>91-10-08 | K. Kelly<br>Prepared By<br>S M Kuster<br>Checked By<br>Dwg. Qual<br>S M Kuster<br>Supervised By<br>W V Tucker<br>Approved By |
| D | CCP HSV-H91-017<br><br>This specification volume has been totally revised to:<br>1. Change the format to comply with DI-CMAN-80008A.<br>2. Incorporate the tailoring instructions into the body of the text.<br><br>The incorporation of tailoring instructions into each specification volume has caused a change in the number of specification volumes from fourteen to thirteen. Prior to this change, all tailoring instructions were provided in Volume XIII and Volume XIV contained the Tactical and Natural Environment segment specification. The content of Volume XIII has been integrated into the other specification volumes. The change is summarized as follows:<br><br>**Volume** **IS** **WAS**<br>I through XII Titles for these volumes are unchanged<br>XIII Environment Tailoring Instructions<br>XIV "Deleted" Tactical and Natural Environment | 93-08-23<br><br>93-08-23<br><br>93-08-23<br><br>93/08/24 | PREPARED<br>CHECKED<br>SUPERVISED<br>APPROVED |

DD-6000-4530 ORIG. 12/87